

## **INTRODUCTION**

Video-assisted thoracoscopic surgical (VATS) procedures are being used in children since 1970s.

With the advent of smaller endoscopic instruments and improvement in video technology, more VATS procedures are being performed. These procedures are very safe and efficacious in paediatric patients of all age groups including newborns.

Initially, the usefulness of thoracoscopy was limited to only biopsies, decortication and deroofing of pulmonary cysts. Today, more than 20 types of VATS procedure have been introduced in infants and children. They mainly deal with diseases of the esophagus, lungs, mediastinum and diseases of the diaphragm, pleura and pericardium.

VATS obviously has certain advantages such as superior cosmetic results, prevention of functional disorders of the thorax, lesser post-operative pain and faster recovery. Endosurgery has a considerable learning curve. Future of the thoracoscopy in children depends upon creation of better and new instruments.

With this background, the present study is intended to analyse, various thoracoscopic procedures performed in our institution, and examine the merits and demerits of this procedure.

## **AIMS OF THE STUDY**

To analyse the usefulness of thoracoscopy in Paediatric population in the management of various thoracic pathologies in relation to its

Feasibility

Safety

Efficacy

Reliability

To compare its advantages over thoracotomy in relation to

Post operative pain

Recovery

Morbidity

Cosmesis

To compare our results with other studies.

## **MATERIALS AND METHODS**

**Design:** This is a retrospective and prospective study analyzing various procedures performed at **Coimbatore Medical College Hospital** and the outcome of the various procedures were evaluated.

**Study period:** This study retrospectively analysed the records of patients who had undergone thoracoscopic procedures for various pathologies during **January 2001 to December 2005**.

**Study center:** Study carried out at the Department of Paediatric Surgery, **Coimbatore Medical College Hospital**.

**Subject:** Totally 30 patients had undergone either diagnostic or therapeutic thoracoscopic procedures at our department during the study period.

### **Instruments Used:**

Zero and 30 degree 4 mm telescope (Karl Storz)

30 degree 10 mm telescope (Karl Storz)

Diathermy : Martin/Aesculop

Light source : Xenon

Camera : (Karl Storz)

Insufflator : CO<sub>2</sub> – automatic

Monitor

Video recorder

**Hand instruments:**

Interchangeable with laparoscopic procedures

**Technique:**

All patients who were investigated and confirmed of their diagnosis were taken up for therapeutic procedures. All patients received general anaesthesia, controlled ventilation, lateral decubitus position with the side of the pathology remaining upwards. Dual lung ventilation was used. Pneumothorax was created with CO<sub>2</sub> or atmospheric air. Number of ports varied according to the pathology and as per the need. No specialized instruments were used. All patients received chest tubes following the procedure. Post operative analgesia was provided as per need.

## **REVIEW OF LITERATURE – THORACOSCOPY**

### **a. Introduction and History of minimal access surgery**

Thoracoscopy is the use of a lighted telescope which is introduced into the thoracic cavity to diagnose or treat intrathoracic pathology. The technique was first described by Jacobaeus in 1910<sup>1</sup>. He is credited as the father of thoracoscopy. In 1921, Unverricht reported 1,500 thorascopies performed over a period of 16 years with no injuries. In 1970, Rodger et al performed small biopsies, intrathoracic lesions and limited pleural debridement in cases of empyema. The first report of thoracoscopy used in children for mediastinal masses, cysts, masses of pulmonary parenchyma, lung anomalies, spontaneous pneumothorax and empyema, was made in 1971 by Klimkovich et al<sup>2</sup>. In 1990 more advanced diagnostic and therapeutic procedures were performed with the advent of newer equipments (VATS).

## **History of minimal access surgery – Key dates**

1585: Aranzi was the first to use a light source for an endoscopic procedure focusing sunlight through a flask of water and projecting the light into the nasal cavity.

**1806:** Philip Bozzini built an instrument that could be introduced into the human body to visualize the internal organs. He called this instrument 'Lichtleiter'<sup>3</sup>.

**1853:** Antony Jean Desormeaux, a French surgeon first introduced Lichtleiter into a patient. He is considered as father of endoscopy<sup>4</sup>.

**1901:** First experimental laparoscopy was performed by a German surgeon, George Kelling, who used a cystoscopy to peep into the abdomen of a dog after first insufflating it with air<sup>5</sup>.

**1910.** H.C. Jacobeus of Stockholm published a discussion of inspection of pleural, pericardial and peritoneal cavities.

**1920:** Zolikofer of Switzerland discovered the benefit of the use of CO<sub>2</sub> for insufflation.

**1929:** Kalk, a German physician introduced forward oblique 135 degree view lens system. He is considered the father of modern endoscopy<sup>6</sup>.

**1938:** Janos-Veress of Hungary developed specially designed spring loaded needle.

**1953:** Rigid rod lens system was discovered by Prof.Hopkins.

**1960:** Kurt Semm a German Gynaecologist who invented the automatic insufflator.

**1978:** Hassan introduced an alternate method of trocar placement.

**1980:** VATS introduced

**1994:** A robotic arm was devised to hold the telescope as a camera operator.

**1996:** Robotic telesurgery was performed.

## **b. Instrumentation**

Instruments used in thoracoscopy are the same as those used in Laparoscopy. Recently, specialized shorter instruments are used exclusively for thoracoscopy.

### **Videosystem - Cameras**

1. Single chip camera
2. Triple chip camera
3. 3-D system

### **Monitors**

1. Resolution
2. Size of the monitor

### **Video documentation**

- |                  |                       |
|------------------|-----------------------|
| 1. VHS recorders | 3. Hard Copy Printers |
| 2. HI-8 recorder | 4. Disc Recorders     |

### **Light source**

1. Halogen
2. Xenon

### **Telescopes**

1. Straight zero degree

Ranges from 2 – 5 mm and 10 mm

Hydrolaparoscope

Videolaparoscope

2. Angled 30-70 degree

3. Flexible scope

4. Operating laparoscopes

Right angled endoscope

Instrumentation

### **Insufflation**

1. Manual
2. Automatic



**Instruments:** Graspers, trocars, dissectors, scissors.

1. Disposable
2. Non disposable

### **Suturing devices**

1. Needle holders
2. Knot pushers
3. Sutures
4. Pretied loops
5. Staplers
6. Knot tiers

### **Devices for tissue extraction:**

1. Pouches
2. Bags
3. Extraction/biopsy forceps
4. Morcellator

### **Accessories**

1. Suction irrigation devices
2. Retractors and dissectors

## Thermal energy

1. Lasers
2. Electrosurgical – Monopolar, Bipolar
3. CUSA (Harmonic Scalpel)

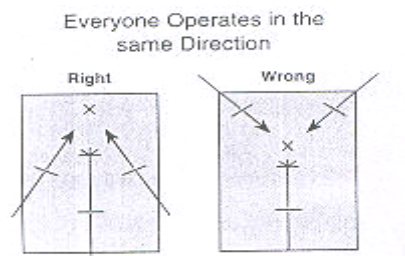
4 mm zero degree telescope is commonly used . 10 mm scope is used for older children of 7 to 8 years age. Thoracoport trocars are specially designed for thoracoscopy. They are short and blunt trocars with valve mechanism for airtight procedures, available in 5 to 15mm diameters.

Endo GIA staplers are very useful instruments for resection, 30 and 60 mm length are available.

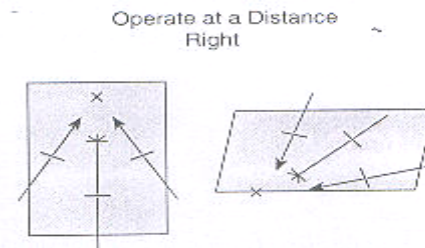
## Ergonomics

Principles involving placement of Thoracoscopy ports

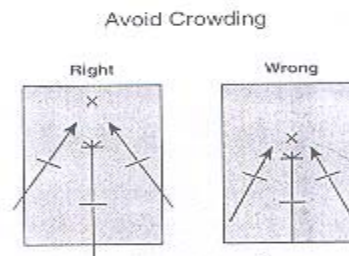
1. Viewing telescope and instrumentation should all be placed so that they are facing in the same direction.



2. The tendency to place the ports close to or immediately adjacent to the target should be avoided.



3. There should be a significant distance between the viewing ports and the working ports.



### c. Anaesthesia for thoracoscopy

Anaesthesia for paediatric thoracoscopy is a very challenging one. The Anaesthesiologist has to be efficient in the various techniques of one lung ventilation.

**Pre-operative evaluation:** Similar to those presenting for open thoracotomy.

Complete history, physical examination, Haemoglobin, Haematocrit, LFT, electrolytes and Chest X-ray.

Additional evaluation ( when required)

PFT and ECG

**Standard pre-operative monitoring:** ECG, pulse oximetry, End tidal CO<sub>2</sub>, non-invasive BP monitoring.

**Premedication:** Midazolam and Atropine – 0.3 mg/kg and 0.02mg/kg respectively.

### **Types of Anaesthesia used**

1. Local anaesthesia may be used in older children more than 8 years of age<sup>7</sup>.
2. Regional techniques and LA. Maintained in spontaneous ventilation, less intervention with surgical procedure.
3. General anaesthesia

Induction:

Inhalational - Halothane or Sevoflurane.

Intravenous - Thiopentone and Propafol

followed by neuromuscular blockade

Intraoperative analgesia; Fentanyl 1-2microgram/kg,

Pentazocin 0.6 mg/kg.

Anaesthesia maintained by inhalation agents or propafol infusion for minor procedures. For major procedures controlled ventilation using muscle relaxants is done.

**One lung ventilation:** Thoracoscopy is performed with a technique to isolate the lung and provide one lung ventilation. This allows the lung on the involved side to be collapsed and motionless.

**Technique for one lung ventilation:**

1. Selective main stem intubation
2. Double lumen endotracheal tube
3. Bronchial blockers

Double lumen tube is preferable when size permits.

CO<sub>2</sub> insufflation into the operative hemi-thorax is used to facilitate collapse of the lung. This is particularly useful in smaller children.

**d. Thoracoscopic procedures in children:**

There is a wide variety of indications for thoracoscopic procedures in children. Currently thoracoscopy is used extensively for lung biopsy, wedge resection in case of interstitial lung disease and metastatic lesions.

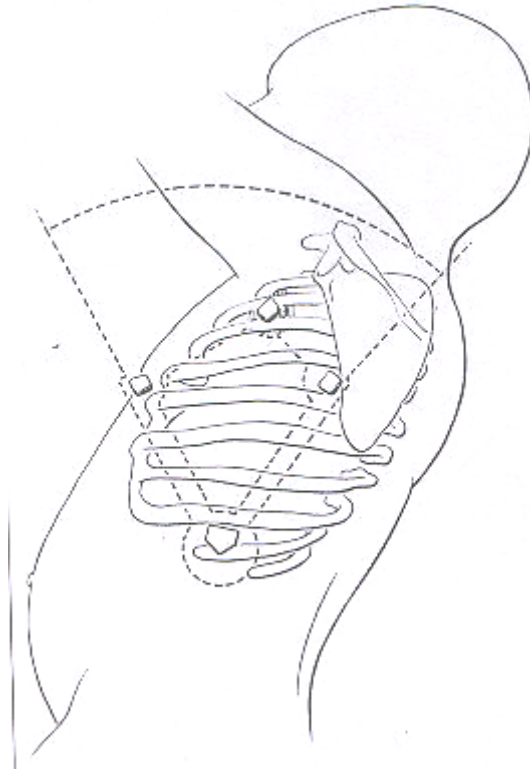
**Spectrum of VATS procedures in children:**

<b>DIAGNOSIS</b>	<b>PROCEDURE</b>
Esophageal atresia	Anastomosis and fistula closure
Duplication cyst	Resection
Esophageal diverticula	Resection
Esophageal stenosis	Esophagectomy and replacement
Pulmonary disease	Lobectomy
Pulmonary sequestration	Resection
Bronchogenic cyst	Resection
Empyema	Decortication
Pneumothorax	Pleurodesis
Diaphragmatic hernia	Hernia closure
Eventration of diaphragm	Plication
Diaphragmatic rupture	Reconstruction
Pericardial effusion	Pericardial Fenestration
Pericardial cyst	Resection
Tracheal instability	Aortopexy
PDA	Ligature
Palmar hydrosis	sympathectomy
Chylothorax	Thoracic duct ligation

GER	Fundoplication
Achalasia	Cardiomyotomy
Spine deformity	Spine correction
Solid neoplasm	Resection biopsy
Sternal deformity	Nuss procedure

**Positioning of the patient:** Positioning depends on the site of the lesion and type of the procedure to be performed. Most of the procedures are done in lateral decubitus position.

**Trocar placement:** Trocar position varies with the operation being performed and the site of the lesion. Trocar should be placed in the anterior, middle and posterior axillary line between fourth and eighth spaces. Pneumothorax created with 5 to 8 mm of CO<sub>2</sub>. Most of the procedures can be done with 3 ports. If needed additional fourth port may be inserted. These ports are placed like a baseball diamond.



Some of the standard thoracoscopic procedures have been discussed in detail here for comparative analysis later on.

**1. Procedures for Empyema:** Empyema thoracis is defined as a pleural space suppurative fluid collection. Para pneumonic effusion is the most common etiology for empyema in children. There are three progressive phases of empyema<sup>8</sup>



1. Early exudative phase
2. Intermediate fibrinopurulent phase
3. Late organizing phase

Diagnosed by symptomatology, Chest X-ray, USG, CT and pleural aspirate.

### **Features of pleural aspirate**

Early phase: pH < 7.2

Glucose < 40 mg/dl

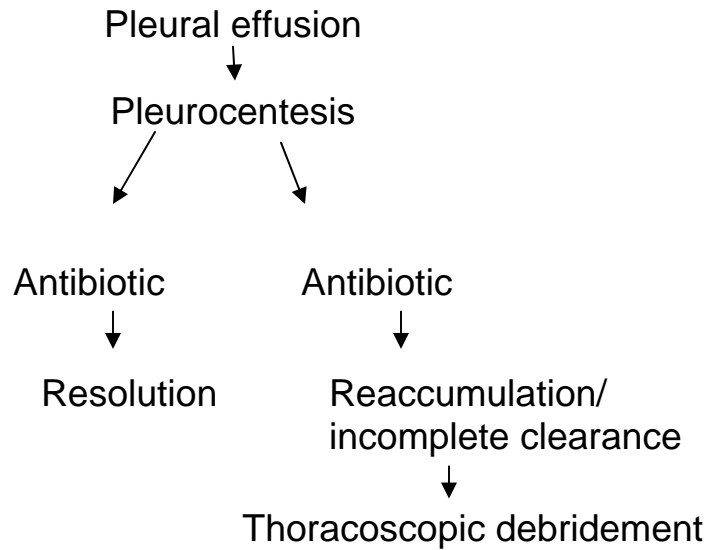
LDH > 1,000 units/dl

WBC > 500 cells/microlitre

Specific gravity – 1.018

**Fibrinopurulent:** Thick opaque fluid

## Management algorithm



**Technique:** ET-GA, main stem intubation of the contralateral lung, lateral decubitus position, two ports, anterior and posterior axillary line, 10 mm for camera. CO<sub>2</sub> flowrate 1lt./mt. CO<sub>2</sub> pressure 5 – 8 mm of mercury. 5 mm 30 degree scope for smaller children. Suction device inserted. Remove as much fluid as possible. Mobilisation of fibrous peel done with blunt grasper. Once majority of the peel is removed and all loculations are broken down, chest cavity is irrigated with 1 to 2 liters of normal saline. Antibiotic may be added. All trocars are removed. ICD is inserted.

**Discussion:** Thoracoscopy provides an effective and minimally invasive method of pleural debridement in children with complicated empyema. It should be applied in the early stages of empyema prior to the development of fibrothorax.<sup>9</sup>

**VATS pericardial resection:**

VATS provides a safe effective approach to the drainage of both benign and malignant pericardial effusion. Large pericardial windows can be created anterior and posterior to the phrenic nerves.

**Technique:** Lateral decubitus position, General anaesthesia, Right sided approach is chosen. 10 mm port introduced in the 7<sup>th</sup> intercostal space midaxillary line, 30 degree scope used, A sixth IC space anterior axillary line port introduced. Phrenic nerve is identified and avoided. Pericardial window created anterior and posterior to phrenic nerve. Pericardial effusion is drained. ICD is kept to drain the pleural space.

**Discussion:** Avoids thoracotomy in an already sick patient, leading to early recovery.

**CDH Repair:**

Neonatal thoracoscopic repair of CDH is safe in selected patients who have good pre-operative pulmonary function.

**Selection Criteria:**

Intra-abdominal stomach position

Good preoperative pulmonary function

Clinically stable pulmonary hypertension.

**Operative Technique:**

ET-GA, controlled ventilation, lateral decubitus position, 5 mm 30 degree scope introduced in 4<sup>th</sup> intercostal space anterior axillary line. 5 mm of Hg insufflation pressure. Two additional ports in 5<sup>th</sup> or 6<sup>th</sup> posterior axillary line and 6<sup>th</sup> or 7<sup>th</sup> anterior axillary line. Contents reduced with insufflation and instruments. Defect in the postero-lateral aspect identified, sutured with 3-0 ethibond reinforced with Teflon pledgets. Ports closed with 4-0 PDS.

**Discussion**

Comparing thoracoscopy to the laparoscopic approach for CDH repair, the operation from the chest is easier. Insufflation helps to reduce the intestines into the abdomen. But with the selection criteria, only 25-35% of the cases with CDH will be candidates for thoracoscopic repair<sup>10</sup>.

**Eventration Repair**

Unilateral diaphragmatic eventration requires plication in cases of progressive dyspnoea on exertion and recurrent respiratory infection. Only very few reported series are available for thoracoscopic repair of eventration.

**Procedure:** GA, lateral decubitus position, lung collapsed by pneumothorax with CO<sub>2</sub> insufflation. Surgeon standing in front of the child. Camera port through 4<sup>th</sup> intercostal space, midaxillary line. Working ports through 4<sup>th</sup> intercostal space anterior and posterior axillary line. Redundant diaphragm was pulled and plicated with interrupted sutures using Ethibond 2-0 extra corporeal knots. Running sutures can also be placed, but it requires extra port to maintain tension. ICD is not required.

**Discussion:** Thoracoscopy seems to be a better approach for repairing defects in the diaphragm when compared to laparoscopy<sup>11</sup>. Pleural cavity is large and allows manipulation of the surgical instruments better. Plicating the diaphragm by thoracoscopy is feasible, safe and easy to perform and efficient.

### **Mediastinal Node biopsy**

Thoracoscopy represents an elegant technique for the diagnosis of mediastinal masses in children. Entire mediastinal compartment, anterior and posterior to the hilum of the lung can be visualized.

**Procedure:** GA-ET, one lung ventilation with contralateral mainstem intubation. Lateral decubitus position, camera port mid-

axillary line, 6<sup>th</sup> intercostal space, 5 mm or 10 mm zero degree scope used, pneumothorax created by opening the cannula to atmospheric pressure. Mediastinal lesion is identified. Two working ports introduced, one anterior and posterior to telescope. Mediastinal pleura over the mass incised. Mass bluntly dissected to expose it completely. Node excised with the help of cautery or scissors and Removed through one of the ports. Ports closed with 4-0 PDS.

**Discussion:** Thoracoscopy is proven to be a safe and reliable method of achieving a tissue diagnosis in patients with mediastinal mass. Diagnostic accuracy is more than 95%.

### **Bronchogenic and Foregut duplication cysts**

Cystic lesions of the thoracic cavity in children can be treated easily with thoracoscopic excision.

**Procedure:** GA-ET, one lung ventilation, lateral decubitus position with side of lesion in the upper most position, esophageal bougie is passed in case of esophageal duplication. Ports introduced as needed. CO<sub>2</sub> insufflation given, mediastinal pleura incised by scissors. Dissection carried out mobilizing the cyst all around. Cyst aspirated, wall excised with the help of diathermy, except on its medial attachment to the vital structures. Mucosal surface ablated

with laser. As a rule chest tubes are not inserted. Bronchogenic cysts are excised in a similar manner. Bronchi are clipped with 5 mm haemostatic clips or oversewn. Chest tube inserted.

**Discussion:** Bronchogenic cysts and duplication cysts can be excised safely and effectively by thoracoscopic approach <sup>12</sup> and the morbidity of thoracotomy can be spared.

#### **e. Complications of VATS:**

Most of the complications described with thoracoscopy are very mild in nature. These are described under the following sections:

##### **1. Anaesthesia related**

- a) Hypoxia
- b) Hypercarbia
- c) Hypotension
- d) Arrhythmias
- e) Pneumothorax

##### **2. Instrument or trocar insertion related**

- a) Adhesions
- b) Intercostal bundle injury
- c) Lung parenchymal injury
- d) Missed pathology
- e) Instrument breakage, misuse or malfunction

3. Post operative

- a) Atelectasis
- b) Infection
- c) Ventilator dependency

4. Complications related to specific procedures:

- a) Retraction damage to parenchyma
- b) Damage to vessels
- c) Bleeding
- d) Nerve damage
- e) Difficult specimen retrieval
- f) Cardiac injury



## THORACOSCOPIC PROCEDURES AT OUR INSTITUTION

The present study analyses various thoracoscopic procedures done in our Department and has reviewed the outcome of various procedures.

Total number of case – 30.

Diagnosis	Procedure	No. of patients
Empyema thoracis	Diagnostic thoracoscopy & Open decortication	8
Empyema thoracis	Thoracoscopic decortication	12
Pyopericardium	Window pericardiectomy	3
CDH	Repair	2
Eventration	Plication	1
Bronchogenic cyst	Excision	1
Foregut Duplication Cyst	Excision	1
Lymphoma	Mediastinal node biopsy	1
TEF	Repair	1

### 1. Empyema thoracis:

Number of patients treated - 20

This study has reviewed the records of 20 patients who were diagnosed as pyothorax. Most of the patients were received from

corresponding medical unit or referred from other hospitals as empyema thoracis.

**Procedure:** Patient received general anaesthesia, endotracheal tube with controlled ventilation. Patient placed in lateral decubitus position with diseased side upwards. Patient received two to four ports according to the needs. Depending on the stage of the disease either thoracoscopy alone or thoracoscopy followed by open thoracotomy was done if fibrothorax was present. Intercostal drain placed through one of the port sites. Pus was sent for routine examination and culture. ICD removal done after three to five days. Follow-up chest x-rays taken.

### **1. Pyopericardium:**

Number of patients: 3

This study has analysed three patients with pyopericardium managed thoracoscopically by the way of window pericardiectomy. All the three patients were investigated and evaluated with chest X-ray, ECG and Echo cardiography and found to have moderate amount of pericardial collection. Patients were posted in a semi-elective list. None of the procedure was done in the emergency setting.

**Procedure:** GA, with endotracheal tube, conventional method, lateral decubitus position, left side up, three ports introduced, 10mm camera port in two patients and 4 mm camera port in one. Two working ports (5mm) in fourth intercostal space were introduced. Adhesions between lung, pericardium and chest wall were removed. One patient had purulent material in the pleural cavity as well, which was removed. Pericardium was fenestrated with the help of scissors. Pus drained, window was made bigger with the help of monopolar diathermy. Pleural cavity drained by chest tube. Post operative period was uneventful.

### **Congenital Diaphragmatic Hernia (Bochdalek):**

Number of patients: 2

This study has retrospectively analysed the records of two patients who were managed by thoracoscopic repair. One was a newborn presenting with respiratory distress and the other was a 4 year old presenting with recurrent respiratory tract infection.

**Procedure:** GA, endotracheal tube, controlled ventilation, conventional anaesthesia, in lateral decubitus position, left side up, three ports used. 4mm and 10mm camera ports were used in

the newborn and the 4 year old respectively. A fourth port introduced without trocar for holding sutures. Contents were reduced with pneumothorax and with forceps. Mobilisation of the posterior lip was done and repair done with 3-0 ethibond continuous sutures and 2-0 ethibond interrupted reinforcing sutures. ICD was kept.

## **2. Eventration of diaphragm**

Number of patients: 1

This study has retrospectively analysed the records of one patient who was managed by thoracoscopic plication of right diaphragm. Patient had presented with recurrent respiratory infection. Diagnosis was confirmed by x-ray chest and CT.

**Procedure:** GA, endotracheal tube, controlled ventilation, conventional, in left lateral decubitus position, three ports used. 10 mm camera port , and two 5 mm working ports used. Pneumothorax created upto 8 mm. Diaphragm plicated with 3-0 prolene continuous sutures. ICD was kept.

### **3. Bronchogenic cyst**

Number of patient: 1

This study has retrospectively analysed the records of one patient who was managed by thoracoscopic excision. Patient has presented with fever and respiratory infection. Diagnosed with chest X-ray and CT scan.

**Procedure:** GA, endotracheal tube, controlled ventilation, conventional, in left lateral decubitus position, three ports used. 10 mm camera port , and two 5 mm working ports. Pneumothorax created upto 8 mm. Thoracic cyst found in the right apex. Purulent material aspirated. Cyst dissected all around, decompressed and excised using diathermy. No communication to bronchus noted. ICD kept.

### **4. Foregut duplication cyst**

Number of patients: 1

This study has analysed the records of one patient who was managed by thoracoscopic excision. Patient has presented with recurrent respiratory tract infection and severe dyspnoea. Investigated with chest X-ray and CT scan which showed cystic lesion in the mediastinum.

**Procedure:** GA, endotracheal tube, controlled ventilation, conventional, in left lateral decubitus position, three ports used. 10mm camera port , and two 5 mm working ports. Pneumothorax created upto 8 mm. Mediastinal pleura opened. Cyst aspirated. Cyst wall grasped and completely excised with diathermy. No communication to esophagus noted. ICD was kept.

## **5. Mediastinal Node biopsy**

Number of patients: 1

This study has retrospectively analysed the records of one patient who was managed by thoracoscopic node biopsy. Patient presented with persistent fever. Investigations were non-contributory except for CT chest showing mediastinal widening.

**Procedure:** GA, endotracheal tube, controlled ventilation, conventional, in left lateral decubitus position, three ports used. 10 mm camera port , and two 5 mm working ports. Pneumothorax created upto 8 mm. Mediastinal pleura opened. Enlarged lymph nodes identified and dissected. Node removed in toto. ICD was kept.

## 6. Esophageal Atresia with TEF

Number of patients: 1

This study has retrospectively analysed the records of one patient who was managed by thoracoscopy converted to open fistula ligation with end to end esophageal anastomosis.

**Procedure:** GA, endotracheal tube, controlled ventilation, conventional, in left lateral decubitus position, three ports used. 4 mm camera port and two 5 mm working ports. Pneumothorax created with 6 mm CO<sub>2</sub>. Esophageal atresia with distal fistula was made out. Azygous vein identified and mobilized. Upper pouch identified and mobilized. Distal TEF identified and mobilized. Due to lack of space and haemodynamic instability, converted to open. Open procedure done by conventional method. ICD was kept.

## RESULTS & OBSERVATIONS

The various observations made in this retrospective and prospective study were recorded and analysed.

The following results were obtained.

Number of cases studied. 30

**Chart - 1**

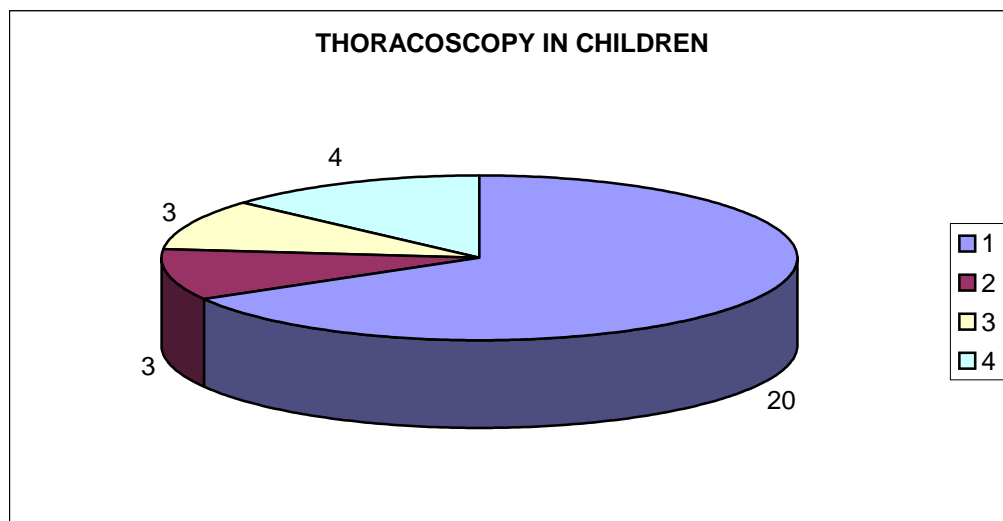


Chart 1 shows distribution of various thoracoscopic procedures done and reviewed in this study.

Empyema Thoracis	– 20	No. 1
Pyopericardium	– 3	No.2
CDH & Eventration	– 3	No.3
Node Biopsy	– 1	} Others No. 4
Bronchogenic cyst	– 1	
Duplication Cyst	– 1	
OA & TEF	– 1	

Chart 1 shows most of the Procedure done were decortication for Empyema Thoracis.



**Chart - 2**

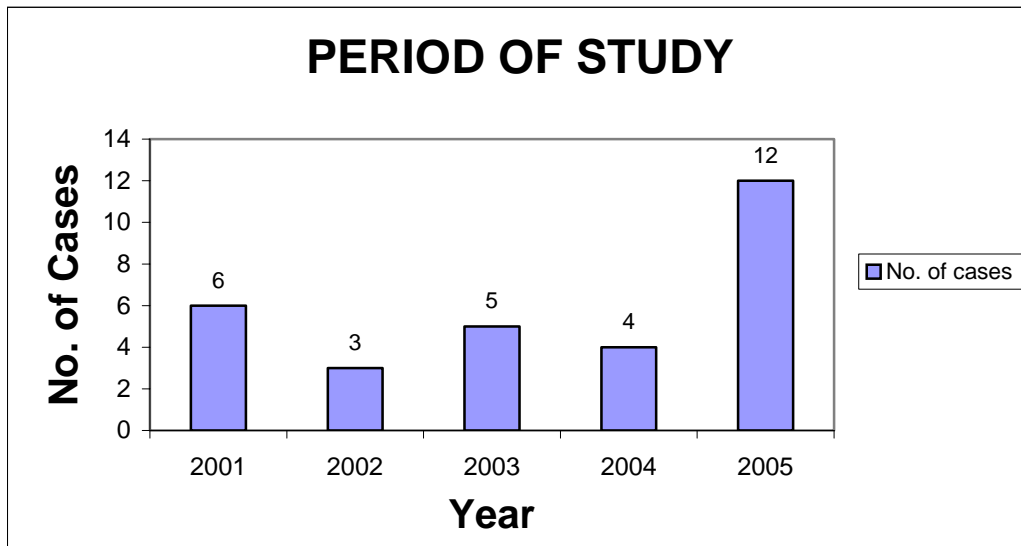


Chart 2 shows the year wise distribution of the patients who had undergone thoroscopic procedures. This chart shows most of the Thoroscopic Procedure were done in the year 2005 .

**Chart - 3**

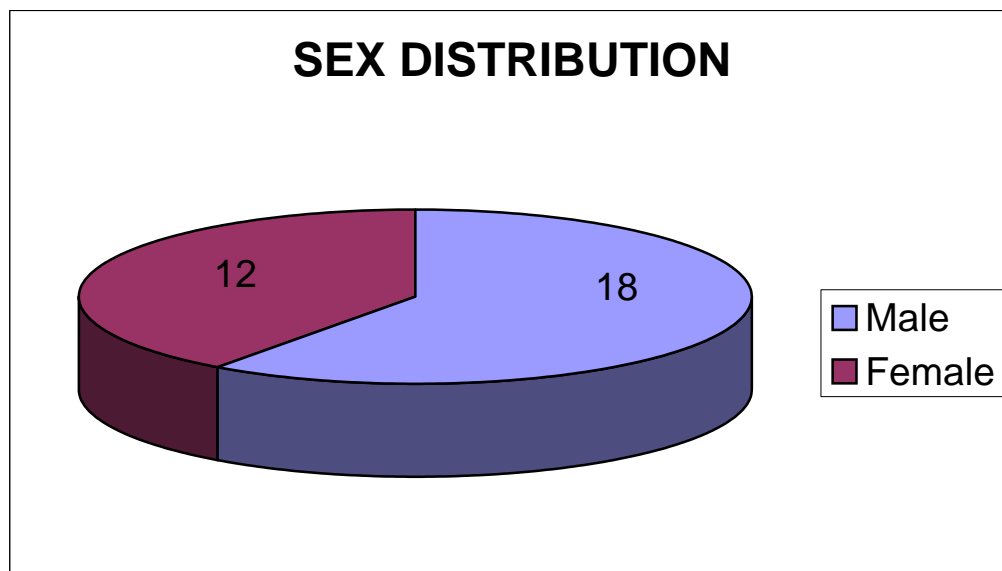


Chart 3 shows the sex distribution of the patients who had undergone thoroscopic procedure and this chart shows that most of the procedures were done in boys .

**Chart – 4**

Showing various Age groups and its distribution

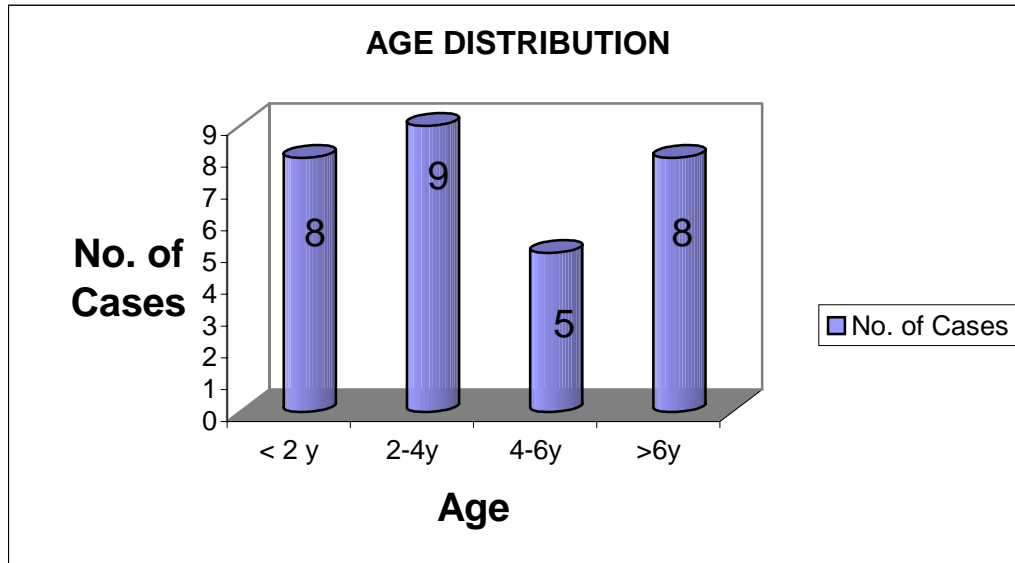
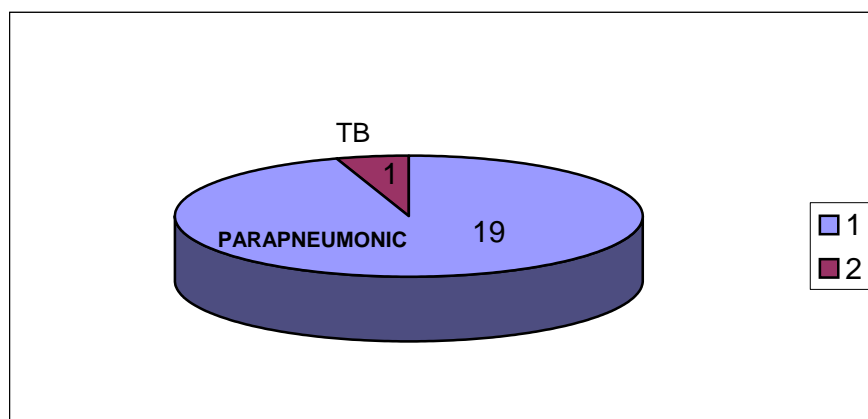


Chart 4 shows age-wise distribution of the patients who were included in this study.

### **Empyema Thoracis**

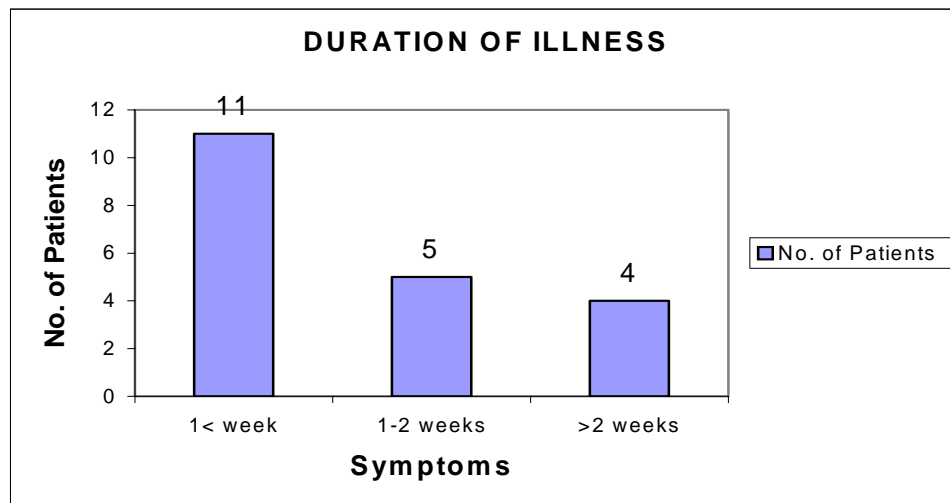
Chart – 5 shows the Etiological distribution of cases of Empyema. Most of the cases were due to Parapneumonic Effusion.

**Chart 5**



**Duration of Illness** : Chart 6 shows the duration of symptoms and the time interval to seek medical help for Empyema Thoracis. Most of the patients seeked medical help within 1 weeks time.

**Chart 6**



**Table – 1**

Duration of Illness	Procedure	
	Thoracoscopy alone	VATS + Open
<1 week 11	9 (82%)	2 (18%)
1 to 2 weeks 5	2 (40%)	3 (60%)
> 2 weeks 4	1 (25%)	3 (75%)

Chart 7 shows the duration of illness and the type of procedure required to manage the patients. It is inferred that if the patient comes earlier for treatment they are managed thoracoscopically.

If the duration is more than 2 weeks most of the patients needed thoracotomy for decortication.

**Table – 2**  
**DIAGNOSTIC THORACOSCOPY & THORACOTOMY**  
**No. of cases – 8**

Sl. No.	Duration of Illness	No. of ports	Blood Transfusion	No. of days (POP)			Outcome
				ICD Kept	Analgesia	Ambulation	
1	1 month	1	yes	4	5	5	Good Lung expansion
2	2 weeks	2	yes	3	3	5	Good lung expansion
3	8 days	2	yes	5	4	6	Good lung expansion
4	2 weeks	2	yes	5	4	6	Good expansion
5	5 days	2	yes	7	5	7	Broncho pleural fistula
6	3 weeks	2	yes	7	3	5	Bil. pleural effusion
7	5 days (conversion)	3	-	10	5	6	Mini Thoracotomy – good expansion
8	1 month (conversion)	3	yes	4	4	5	Good lung expansion

Chart 8 : This chart shows the patients who needed thoracotomy for decortication as the procedure of choice which also shows most of the patients have come with duration of illness more than 2 weeks. Initial thoracoscopy revealed fibrothorax. which is later converted to thoracotomy.

This chart also reveals that the number of ports used is less - 2

Post-operative intercostal drainage - 5 days.

Analgesic requirement - 4.1 days,

Ambulation - 5.8 days

**Table – 3**  
**THORACOSCOPIC DECORTICATION**  
**No. of cases – 12**

Sl. No.	Duration of Illness	No. of ports	Blood Transfusion	No. of days (POP)			Outcome
				ICD Kept	Analgesia	Ambulation	
1	7 days	3	-	3	3	4	Good Lung expansion
2	7 days	4	yes	7	5	6	Good lung expansion
3	2 months	2	-	7	5	-	Expired
4	2 weeks	3	-	3	4	3	Good lung expansion
5	7 days	3	-	3	2	3	Good lung expansion
6	10 days	3	-	3	2	3	Good expansion
7	7 days	2	-	3	2	3	Good lung expansion
8	2 days	3	-	6	2	4	Good lung expansion
9	5 days	2	-	3	2	3	Good lung expansion
10	7days	2	-	3	2	3	Good lung expansion
11	7 days	2	-	2	1	2	Good lung expansion
12	5 days	2	-	2	1	2	Good lung expansion

**Shaded area – Primary Thoracoscopy**

Chart 9 : This chart shows that most of the patients who had come earlier for management of pyothorax needed only thoracoscopic decortication. This chart also shows that

The average duration of ICD                      -        3.7 days  
Post op Analgesia                                       -        2.5 days  
Ambulation                                                 -        3.1 days

Table –4  
PYO PERICARDIUM

Sl. No.	Age & Sex	Duration of Illness	No. of ports	Blood Transfusion	No. of days (POP)			LOS (days)
					ICD Kept	Analgesia	Ambulation	
1	6 years/ Male	7 days	3	Yes	3	3	3	6
2	2 ½ y /Male	15 days	3	Yes	3	2	3	7
3	1 y / Male	10 days	3	-	3	2	3	6

This table shows that the average number of Ports used in each patient is three.

ICD kept for 3 days

Analgesic requirement - 2.3 days

Ambulation - 3 days.

Table – 5  
CDH & EVENTRATION

Sl. No.	Age & Sex	Duration of Illness	No. of ports	Blood Transfusion	No. of days (POP)			Outcome
					ICD Kept	Analgesia	Ambulation	
1	5 years/ Female	2 months	4	-	7	5	7	Good
2	19days/ Female	2 weeks	3	-	3	1	-	Good
3	2years/ Male	1 month	3	-	3	2	3	Good

This chart shows that none of the patients required blood transfusion.

One patient had ICD tube for a longer time because of air leak.

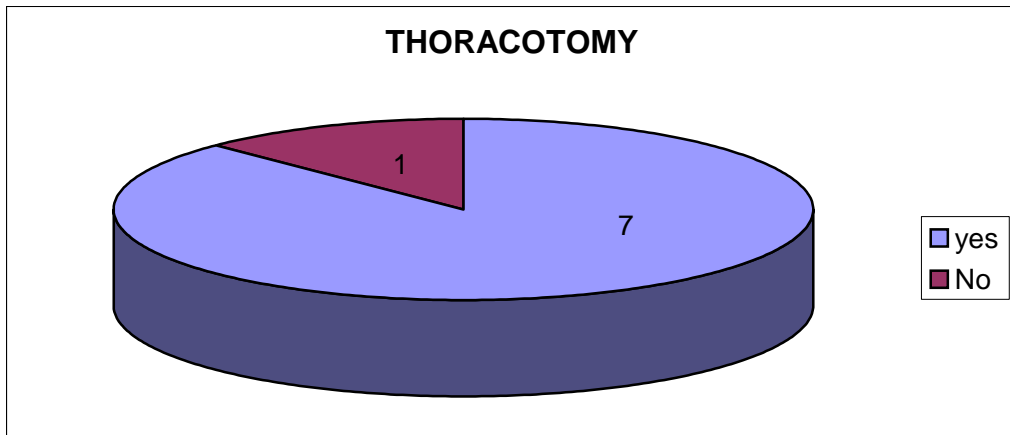
**Table – 6**  
**Anaesthetic Technique**  
**No. of Cases – 30**

One lung ventilation		Dual lung ventilation
Double lumen Tube with Bronchial Blockers	Mainstem Intubation	-
Nil	Nil	30 Cases

**Chart – 7**  
**Blood Transfusion**

Thorocotomy Group

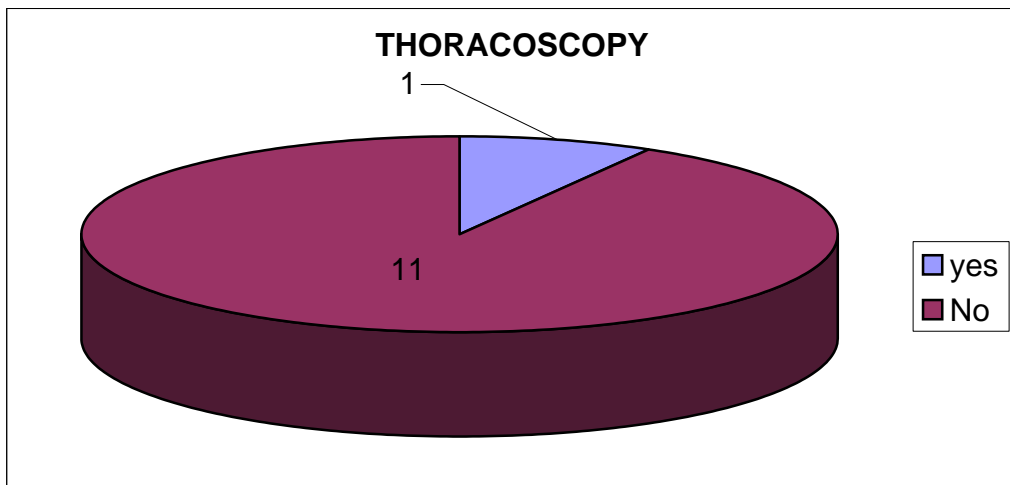
Total No. of Cases – 8 ,Transfusion given – 7 ,No Transfusion – 1



Thoracoscopy Group

Total No. of Cases – 12,Transfusion given – 1, No Transfusion – 11

**Chart-8**



**Table – 7**  
**COMPLICATION**

<b>Total No. of Cases</b>	<b>Anesthesia Related</b>	<b>Insertion Related</b>	<b>Post Operative</b>
30	-	1	1

This table shows the number of patients who had complications in this study group and its distribution.

Prolonged air leak        –        1

Residual disease        –        1

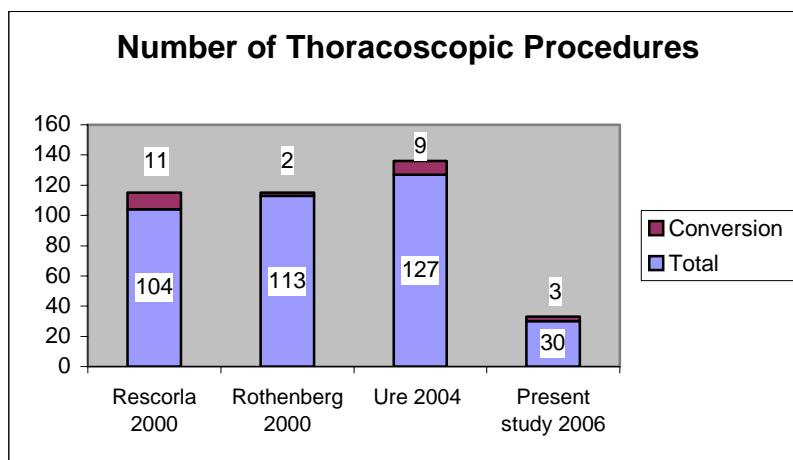
Even though there were two deaths in this series they were unrelated to the thoracoscopic procedure.



## COMPARATIVE ANALYSIS & DISCUSSION

The various results and observations made from this study were compared with similar studies and the outcome is discussed here.

The feasibility and safety of VATS in children has been shown in several series.



Conversion rate according to this series is 7 to 11%

Conversion rate in the present study is 10%

### 1. Empyema Thoracis ( Management algorithm)

According to **one study from Journal of Indian Association of Paediatric Surgery** <sup>13</sup> (July – Sep 2005) The management consensus is according to the duration of illness and Stage of Diseases.

- Stage I - ICD Drainage
- Stage II - VATS Decortication
- Stage III - Open Decortication

The present study has a similar management protocol except that in the latter part of the study there is a trend towards primary VATS decortication even in stage I disease.

### **Duration of Illness & Management**

Another study from Mumbai which was done between June 2000-Dec 2002<sup>14</sup>, had managed 14 patients of pyothorax.

<b>Duration</b>	<b>Thoracoscopic decortication</b>	<b>VATS + Open Decortication</b>
< 1week 10 cases	8 (80%)	2 (20%)
> 1 week 4	1 (25%)	3 (75%)

### **Present Study**

<b>Duration</b>	<b>Thoracoscopic decortication</b>	<b>VATS + Open Decortication</b>
< 1week 11 cases	9 (82%)	2 (18%)
> 1 week 9 cases	3 (33%)	6 (67%)

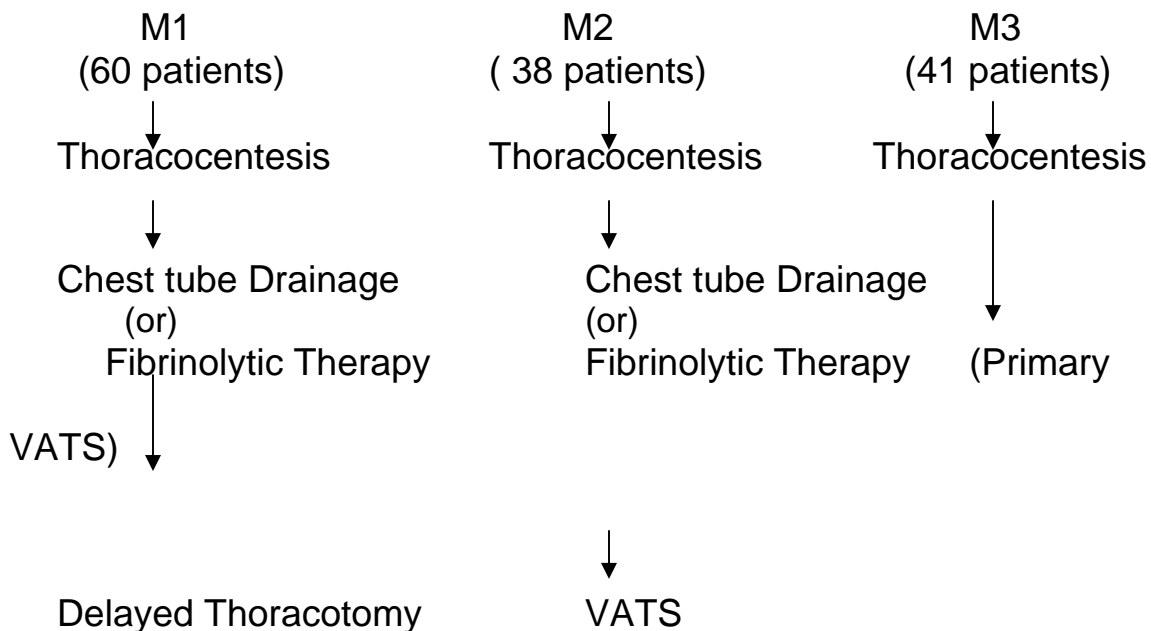
When we compare both the studies the results are similar. If the patients seeks medical help earlier within 1 week, the condition is managed with thorocoscopic decortication.

If the duration is more than 1 week, the management depends upon the stage of the disease and most of the patients will require open thoracotomy which increases the morbidity.

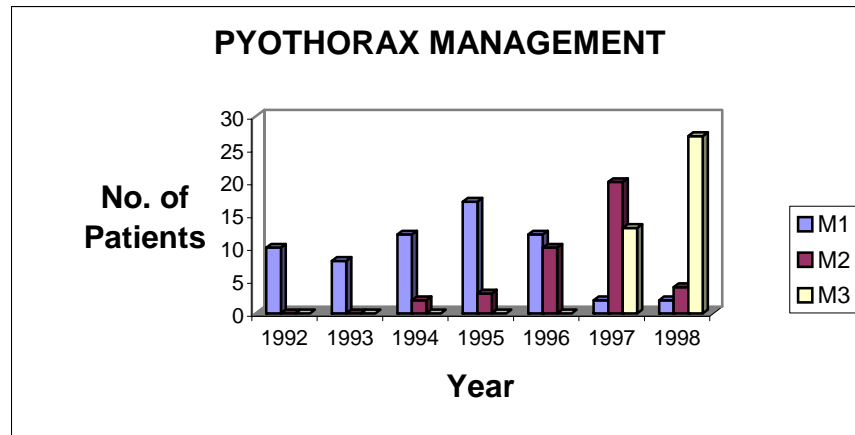
VATS has been used in children for debridement of the pleural space failing conventional management<sup>15</sup>

A retrospective study done at **Dallas, Texas** between Jan 1992 to July 1998 showed the following results.

They divided the patient into 3 groups according to the management algorithm.



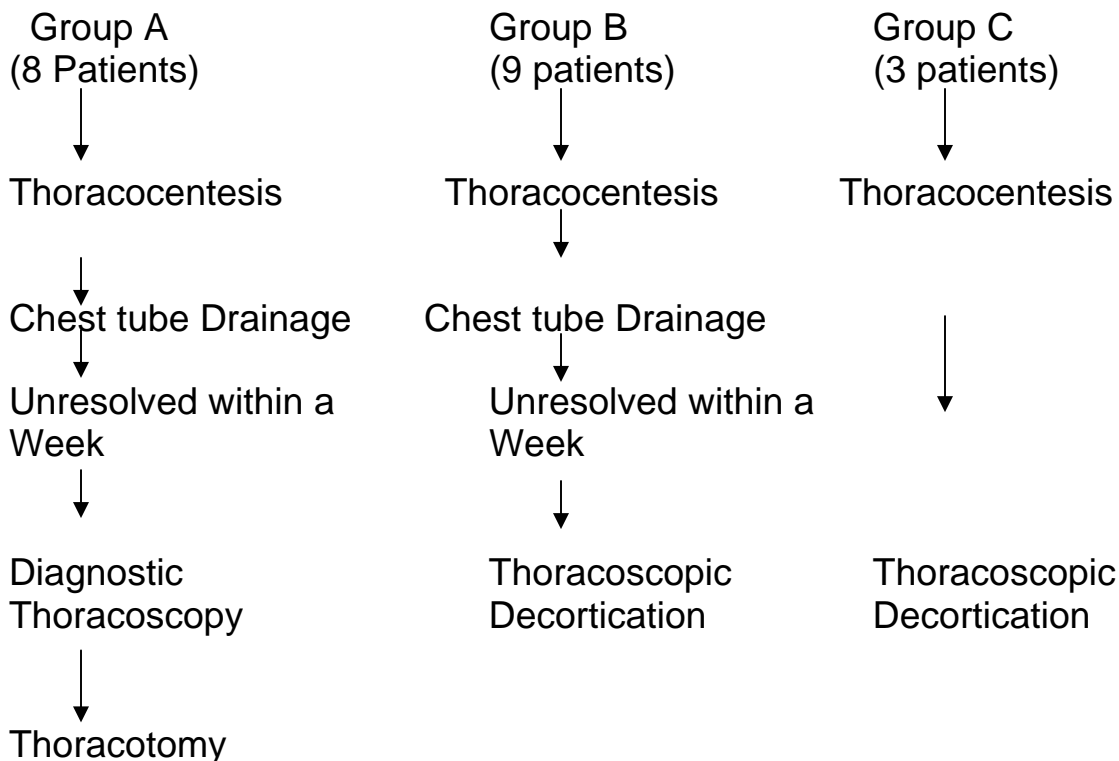
From their study they have analysed that the median length of stay in hospital was significantly lower. The duration of ICD tube drainage is also significantly reduced in patients who have been managed with Primary VATS.



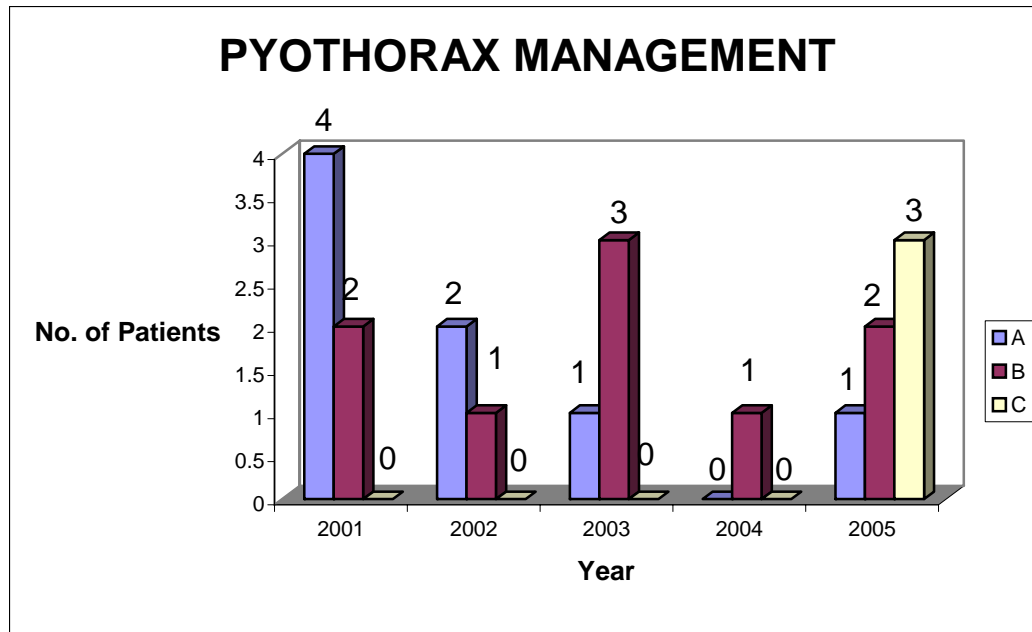
This figure shows that the trend in the management of Empyema Thoracis shifting towards Primary VATS.

**The present study** also has similar trend in the management of Empyema Thoracis.

Initially the patients referred to the study center with chest tube placed already. The management sequence is as follows:



If we look at the latter part of the study the trend is toward primary VATS as the patients are referred earlier without chest tubes.



A – Throacotomy

B – Secondary VATS

C – Primary VATS

But in the present study Fibrinolytic therapy was not used.

	M1	M2	M3	P value
	Median (No. of Children)			
No. of procedures Per child	2 (60)	2 (38)	1 (41)	<.001(M1 from M2 from M3)
Duration CT (d)	5 (43)	3 (38)	3 (41)	<.001 (M1 from M2, M3)
No. of preoperative days	9 (60)	5(38)	6 (41)	<.005(M1 from M2, M3)
Length of stay (d)	12(60)	11(38)	7(41)	<.001(M1,M2 from M3)

	A (8 Patients)	B (9 Patients)	C (3 Patients)	P value
	Average (days)			
Duration of Chest tube (days)	5	3.7	2.3	-
Length of stay (days)	8.6	5	4	-

When we compare the study group with above study the number of days with chest tube, early ambulation is similar to that of above group. Primary thoracoscopy has a better outcome when compared to other procedures. Since the study group is very small 'P' value is statistically insignificant.

#### **Results of VATS in the Treatment of Paediatric empyema.**

Reference	Patients (N)	Preoperative Chest tube (Days)	Postoperative Chest tube (days)	Postoperative LOS (Days)	Total LOS (Days)	Recurrence, Failure, or Death (N)
Kern & Rodgers (1993)	9	6.9± 1.8	8.4 ± 4	13.4 ± 2.9	NA	1
Stovroff et.al. (1995)	12	4 to 6	4	6 to 8	NA	0
Silen & Weber (1995)	3	4 ±1	7 ± 1	8 ± 1	NA	0
Davidoff et.al. (1996)	9	NA	8.5	NA	NA	2
Grewal et. Al. (1998)	25	2 ± 1.6	3.2 ± 2.2	4.9± 2.7	7.3 ± 4	0
Present study (2005)	12	4 to 6	3.7	6 to 8	NA	1

## Pyopericardium

A prospective study conducted at **Central Hospital for children at Vietnam**. July 2002 – June 2004. which showed the length of hospital stay is reduced when pyopericardium is managed by thoracoscopic approach, without much complications.

Management of Pyopericardium Table :

<b>Length of Hospital stay</b>	<b>1-4 days</b>	<b>4-10 days</b>	<b>&gt;10 days</b>
No. of Patients	15	7	2
Present Study	-	3	-

## CDH – Thoracoscopic Approach

A retrospective study conducted at **Ann Arbor, Michigan**, revealed the following data

## Bochdalek Hernias

<b>Age</b>	<b>Approach</b>	<b>Preoperative symptoms</b>	<b>Conversion to open</b>	<b>Length of follow up (mo)</b>	<b>Complications</b>
5d	Laparoscopic/Thoracoscopic	RDS	No	12	Colon perforation
4 d	Thoracoscopic	RDS	Yes	31	
3d	Thoracoscopic	RDS	Yes	18	
21 d	Thoracoscopic	RDS/ECMO	Yes	12	Died at 1 year of age
32 mo	Thoracoscopic	Respirator distress	No	18	
4 mo	Thoracoscopic	Pneumonia	No	2	
11 mo	Thoracoscopic	RDS	No	9	Recurrence at 19 mo

This study reveals that CDH repair in non-newborns is a reasonable option. Thoracoscopy is a better approach for repairing the hernia when compared to laparoscopy<sup>16</sup>. But in newborns CDH repair

should be approached cautiously because of the chances of recurrence and attendant complications.

### CDH & EVENTERATION

#### Present study:

Sl. No.	Age & Sex	Duration of Illness	No. of ports	Conversion	No. of days (POP)			Outcome
					ICD Kept	Analgesia	Ambulation	
1	5 years/ Female	2 months	4	-	7	5	7	Good
2	19days/ Female	2 weeks	3	-	3	1	-	Good
3	2years/ Male	1 month	3	-	3	2	3	Good

In the present study there were no recurrences and complications.

Patient had a very quick recovery.

A study from division of paediatric surgery of **St. Justin Hospital Montreal, Quebec, Canada<sup>17</sup>**, revealed that the Thoracoscopic approach of excision of Isolated duplication cyst has reduced the number of chest tube days and hospital stay when compared to thoracotomy.

#### Excision of isolated FD cysts

	Thoracotomy (n = 16)	Thoracoscopy	P	Present Study
Chest tube duration (d)	3.3 ± 0.4	1.6 ± 0.5	.01	4
Postoperative length of stay (d)	6.6 ± 1.0	2.6 ± 0.5	.002	6



In the present study the number of chest tube days has not reduced significantly but the attendant morbidity and analgesic requirement was reduced significantly.

In most of the reported series the complications in Thoracoscopy are very minimal and are mostly related to Anaesthesia. In our series most of the patient underwent dual lung ventilation with conventional anaesthesia without much complications.

#### COMPLICATION

<b>Total No. of Cases</b>	<b>Anesthesia Related</b>	<b>Insertion Related</b>	<b>Post Operative</b>
30	-	1	1

## **CONCLUSION**

1. Thoracoscopy is definitely superior to thoracotomy in the management of Empyema thoracis in relation to
  - a. Pain relief
  - b. Morbidity
  - c. Early recovery
  - d. Requirement of blood transfusion
2. Primary VATS has a role in the management of empyema thoracis.
3. Thoracoscopy can safely be done in all age groups and even in very sick children.
4. This study reveals that this is an excellent procedure for mediastinal biopsy with a very high yield.
5. This study reveals that thoracoscopy reduces the morbidity and gives better cosmetic results in case of pyopericardium
6. Thoracoscopy definitely reduces the morbidity and hospital stay in cases of CDH repair.

7. Cystic lesion of the lung can be excised safely and effectively by thoracoscopy.
8. Procedures like thoracoscopic esophageal atresia repair need more operative time and expertise and specialized instruments.
9. This study also reveals that thoracoscopic procedures can be done with conventional dual lung ventilation with induced pneumothorax. One lung ventilation or double lumen tubes are not mandatory.
10. Our experience reveals that complications encountered in thoracoscopy are usually minor.

## **PROFORMA**

S.No.

Name:

Age/Sex

PS.No.

IP.NO.

D.O. A.

D.O.S.

D.O.D

Complaints

Duration.

History of present illness

Clinical Features

Investigations

Provisional Diagnosis

Anaesthesia

Ports

Procedure

Post – Op- period

HPE

Final Diagnosis

## MASTER CHART

S. No	Name	Age & sex	IPNO	Duration of symptoms	Ports used	ICD (days)	Anal (days)	Ambulation (days)	Out come
1	Manju	21/2 F	7476	1 month	1	4	5	5	Good
2	Kanniyammal	9 F	7511	5 days	3	10	5	6	Good
3	Vignesh	2 M	4969	7 days	3	3	3	4	Good
4	Lavanya	5F	12223	7 days	4	7	5	5	Good
5	Ranjith	7 M	2849/01	1 month	3	4	4	5	Good
6	Ram Prabakar	2M	11673	2 month	2	7	5	-	Expired
7	Salman	4M	6359	2weeks	3	3	4	3	Good
8	Karunaipriya	4F	10405	8days	2	5	4	6	Good
9	Geetanjali	41/2 F	62679	2weeks	2	5	4	6	Good
10	Sundaram	3 M	8118	8days	2	5	4	6	Good
11	Isakkiammal	1 F	23325	7days	3	3	2	3	Good
12	Swarna	21/2 F	33972	7 days	3	3	2	3	Good
13	Sivaprakasam	71/2 M	35267	5 days	2	7	5	7	Good
14	Manikandan	4M	47501	1 week	2	3	2	3	Good
15	Balakrishanan	8 M	44811	2 days	3	6	2	4	Good
16	Nishanth	9M	61595	3 weeks	2	7	3	5	Good
17	Vikram	10M	35006	1 week	2	3	2	3	Good
18	Mohanapriya	21/2 F	59044	1 week	2	3	2	3	Good
19	Dhanush kumar	7/M	355/06	7 days	2	2	1	2	Good
20	Geetha	1/F	60499	5 days	2	2	1	2	Good

S. No	Name	Age & sex	IPNO	Duration of symptoms	Ports used	ICD (days)	Anal (days)	Ambulation (days)	Out come
21	Vignesh	6 M	14901	7 days	3	3	3	3	Good
22	Jegadeesh	21/2M	36251	15 days	3	3	2	3	Good
23	Hari Muthukumar	1/M	35685	10 days	3	3	2	3	Good
24	Pavithra	5F	148/06	2 months	4	7	5	7	Good
25	B/o. Sumithra	19D F	7228/06	2 weeks	3	3	1	-	Good
26	Chellappa	2/M	61953	1 month	3	3	2	2	Good
27	Vellingiri	9/M	9128	1 month	3	2	1	2	Good
28	Suresh	4/M	58300	1 month	3	4	3	4	Good
29	Anandkumar	5/M	61240	1 month	3	4	3	4	Good
30	B/o.Vidya	1D/F	5321	1 day	3	3	1	-	Expired

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